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ABSTRACT

This study used log-linear modeling to examine responses of high school students enrolled in an interactive video program during the 1995, 1996, 1997, and 1998 program years to open-ended questions concerning the strengths and weaknesses of the program. Respondents, 1,024 students from a rural Appalachian area, were categorized by home or remote site and by semester. Analyses of the strength responses provided a model with a relationship between strength and site and between strength and semester. The weakness response required a model including the interaction of weakness, site, and semester. Results are discussed. (Contains 7 figures and 13 references.) (Author/SLD)

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High School Student Perceptions of the Strengths and Weaknesses of an Educational Interactive Video Program over a Four-Year Time Span: Log-linear Analysis

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Abstract

This study used log-linear modeling to examine responses of high school students enrolled in an interactive video program during the 1995, 1996, 1997, and 1998 program years to open-ended questions concerning strengths and weaknesses of the program. Respondents were categorized by home or remote site and by semester. Analyses of the strength responses provided a model with a relationship between strength and site and between strength and semester. The weakness response required a model including the interaction of weakness, site, and semester. Results are discussed.

High School Student Perceptions of the Strengths and Weaknesses of an Educational Interactive Video Program over a Four-Year Time Span: Log-linear Analysis

Although interactive video technology has advanced rapidly in recent years, there is increasing evidence that no one technology works in every application (Linking, 1989). In some areas differences in culture may dictate different learning methods. Differences in grade and/or age may require different teaching styles. In addition, the technology utilized by interactive video requires a different preparation for teaching than traditional methods (Knapczyk, 1993). While the expenditure required for interactive video may be less than providing on site teachers (Morgan, 1994; Villarroel, 1988) or may provide access to equal educational opportunities in rural areas, there is an increasing need for research into and evaluation of the effectiveness of interactive video programs. In 1989 Prideaux noted that effectiveness was not adequately evaluated. Madan (1997) added that the credibility of interactive video distance learning is questionable unless the quality of the program is assessed. Thus, the need for evaluation of distance education programs seems clear.

Most studies, however, that could be found evaluated a single semester or year and for a single class. Thus, while effectiveness may be evaluated for a short period of time and over an individual class, results for an extended time with multiple classes are still sparse.

The primary purpose of this study was to evaluate the strengths and weaknesses of an interactive video program in a rural Appalachian area in southwest Virginia as perceived by high school student participants. Because attitude is a reflection of the perceived effectiveness of the program, prior results have been used to provide improvements to the program. This analysis

continued an assessment of change over the 4-year life span of the program.

Because the method of analysis influences the interpretation of results, two researchers may provide different answers to the same question. Thus, a secondary purpose of this research was to compare the use of log-linear modeling with categorical data to the use of the chi-square test of independence.

Literature Review

Distance Education

The basic criterion for distance education is distance between the teacher and the student. Distance education is not a new technique. This technique was begun in the nineteenth century with correspondence education (Klesius, Homan, & Thompson, 1997). It has, however, changed from the correspondence delivery method, through radio methods, to today's computer and interactive video techniques.

Increased use of interactive video (ITV) for distance learning students has made classes previously inaccessible to rural high school students available locally. Offering college courses at remote sites by interactive video permits students to take the class without a lengthy drive and, in some localities, homebound students may now partake of classroom interaction by interactive video. Thus, we may perceive interactive video as a means of providing equal educational opportunities to all students. There are, however, questions concerning this program.

Prior researchers in distance education have investigated student satisfaction, communication techniques, teaching behavior, and change fostered (Moore & Thompson, 1990). Because distance education places students in the situation in which there may be no interaction or association with other students or the teacher, system requirements must be sound

(Gunawardena, 1988; as cited in Dillon, Gunawardena, & Parker, 1992). In addition, the importance of the role of the teacher or facilitator has been stressed by several researchers (Garrison & Baynton, 1987 as cited in Dillon, Gunawardena, & Parker, 1992) and interaction with the instructor has been central to the success of a distance education program. When a distance education program has active support, some researchers have found no differences in program rating between home and remote sites. Thyer, Polk, and Gaudin (1997), however, reported that live instruction was rated significantly higher at a college campus than distance learning. They add that distance learning has not yet demonstrated comparable outcomes in terms of student learning.

Although the use of distance education provides the obvious advantage to take otherwise unavailable classes, as the role of distance learning expands, it is essential that the problems unique to this format be examined (Wilson, Litle, Coleman, & Gallagher, 1997/98). What do students perceive as advantages and disadvantages of the distance education program? How do programs change over time? There is also the traditional problem of how to analyze the data collected.

Data Analysis

In analysis of open-ended questions, many times responses are summed to categories and the categories contrasted by chi-square (χ^2) goodness of fit. Categories may then be cross-classified by another factor and independence of variables tested by the χ^2 test of independence. Categories may again be cross-classified by a second factor and the process repeated. This procedure leads to multiple significance tests and provides no method to assess interaction of more than two variables.

Fienberg (1989) says that "the use of multiple two-dimensional tables to analyze data fails to distinguish the relationship when other variables are present, does not permit simultaneous examination of the relationship, and ignores higher-order interactions" (p.1). In addition, the use of multiple tests of significance inflates the type I error rate. Log-linear modeling, on the other hand, permits the user to assess interaction between multiple variables. Thus, a log-linear model provides a better measure to assess multidimensional categorical data.

Bakeman and Robinson (1994) compare the use of a log-linear model to hierarchical multiple regression. Regression predicts scores for an individual. Log-linear modeling predicts scores for a cell. The degrees of freedom for regression are based on number of subjects. The degrees of freedom in log-linear modeling are based on number of cells as is χ^2. Both, however, may use multiple predictors to build the model.

Method

Subjects

High school students enrolled in an interactive video class at a distance education facility in a rural southwest Virginia area were surveyed during the Spring semesters, 1995, 1996, and 1997. During the 1997-98 school year, surveys were submitted to students during both the Fall and Spring semesters. Surveys were administered during the regularly scheduled class time by the class instructor or remote site facilitator.

Measurement

The original survey instrument consisted of demographic information (school, gender, grade, etc.), some 5-point Likert style questions, and three open-ended questions concerning strengths, weaknesses, and suggested improvements for the interactive video program. Two of

the open-ended questions (strengths and weaknesses) were used for this analysis.

Each of the open-ended questions was followed by three blank lines indicating each respondent could provide three answers. Survey responses to the strength and weakness questions during the 1995 and 1996 semesters were coded based on the response. After determining similarities of the responses, these were placed in categories. For example, the strength's response "previously unavailable class" was coded as '8'. It and the responses "less driving" and "classes in my area" were then summed to a major category "access." This resulted in five categories of response.

In an attempt to improve the response rate, for the 1996-97 and 1997-98 semesters, the open-ended questions were changed to provide a selection of five previously determined categories. Respondents were requested to rank the most important categories with 1 representing the most important. The other category was followed by blank lines to enable the respondent to add any needed suggestions.

Although a respondent could provide three answers for each of the open-ended questions, for this analysis, each response was considered to be independent. That is, each individual response to the open-ended questions is the unit of analysis - not the individual respondent.

Analysis

This data was analyzed using hierarchical log-linear modeling. In this procedure, a fit is produced for estimating the number of respondents in each category. For example, if site is a good predictor of number of respondents for the categories of strength (access, student interaction, learning, student behavior, and other), site is included in the model. Likewise, if semester is a good predictor of strength category, it is included in the model. These results could

also be obtained using a chi-square test of independence. Site, semester, and strength, however, could not be included in the same model. Thus, we could not test interactions between site, semester, and strength. The log-linear model tests this interaction.

Results

Descriptives

There were 1024 respondents included in the high school comparison for the four survey years in this analysis. Thirty-three schools were included. Six hundred twenty-five respondents were from home site locations (95 n=66, 96 n=160, 97 n=86, Fall 97 n=85, 98 n=228) and 397 from remote site locations (95 n=40, 96 n=77, 97 n=61, Fall 97 n=63, 98 n=156) with 2 not reporting site (see Figure 1). Respondents were from four grade levels: 8th and 9th grade (n=202), 10th grade (n=183), 11th grade (n=246), and 12th grade (n=384) with 9 not reporting grade. The prevalent reason for taking interactive video classes has been the respondents wanted the class (N=406) or thought it would be interesting (N=246). At the home site, advisors frequently suggested the class (N=226).

Insert Figure 1 About here

Strengths

Nine hundred thirty-six of the high school respondents reported one or more strengths of the interactive video program for a total of 2327 responses. Of these 1419 were home site responses. Perceived strengths of the interactive video program have differed by site during each semester. Typically, access to classes has been cited as a strength by remote site respondents

more frequently while sociability with other students has been the prevalent strength designated by home site respondents (see Figure 2). Over the five semesters, however, the frequency of specifying access has decreased proportionally by respondents at the remote site while the frequency of citing student behavior and learning have increased. In addition, the proportion of responses citing sociability has decreased at the home site while the proportion of responses citing student behavior has increased.

Insert Figure 2 About here

For the analysis of Strength, the best fitting model (χ^2 =25.61, df=16, p=.06) contained the univariate terms site, strength, and semester, as well as the interaction terms, site by strength, site by semester, and semester by strength. There was no interaction between site, semester, and strength.

Across semesters Student Behavior was cited as a strength with increasing proportional frequency. A standardized residual [SR] of ± 2 was used to determine statistically significant changes. In 1995 (SR= -3) and 1996 (SR= -4.6), student behavior was cited significantly less frequently than expected. In the Spring semesters, 1997 (SR=2.1) and 1998 (SR=2.6), student behavior was cited more frequently than expected (see Figure 3). In 1995 (SR=2.7) and 1996 (SR=3.6), sociability with other students was cited significantly more frequently than in other years. Learning and access were consistently cited as strengths by 20% to 30% of the responses across survey semesters. Other strengths cited were less than 10% for each semester.

Insert Figure 3 About here

Home site responses (SR=-2.2) specified access to classes as a strength less frequently than expected while remote site responses (SR=2.7) cited access more frequently than expected. On the other hand, home site responses referred to sociability with other students (SR=2.1) with greater frequency than remote site responses (SR-2.7). Learning (28%), student behavior (15%), and other responses were cited with relatively equal proportional frequency regardless of site (see Figure 4).

Insert Figure 4 About here

Because there was no interaction between site, semester, and strengths, if strengths had been analyzed by two chi-square tests of independence, the results would have been similar.

Weaknesses

Eight hundred ninety-two of the high school respondents reported one or more weaknesses of the interactive video program for a total of 2044 responses. Of these, 1203 were home site responses. Perceived weaknesses of the interactive video program in 1995 were dominated by equipment (53%). This weakness has decreased over the five survey semesters. The proportional frequency of weaknesses reported for scheduling, on the other hand, increased through 1997. Student Behavior and Instruction have increased and decreased depending on semester and site (see Figure 5).

Insert Figure 5 About here

When weakness was analyzed by a log-linear model, there was a three-way interaction between site, semester, and weakness reported. If forced to a model containing only three 2-way interactions, the proportion of responses citing equipment as a weakness was significantly larger at the home site in 1995 (SR= 5.16) and 1996 (SR= 4.06) and the remote site in 1995 (SR= 2.25) than at other times (see Figures 6 and 7). Although the total proportion of respondents citing equipment problems has decreased across survey semesters, there has been a slight increase following the Spring 1997 semester at both sites.

Insert Figures 6 & 7 About here

Weaknesses concerning scheduling problems were infrequently cited in 1995 (SR_{home} =-3.9; SR_{remote} = -3.6) and in 1996 (SR_{home}=-3.4; SR_{remote} = -3.2). By 1997, however, scheduling was cited with increasing frequency by both home and remote site respondents. More than 30% of the weakness responses at the home site reported scheduling problems in the three semesters surveyed in 1997 and 1998 while more than 25% of the remote site respondents reported the same.

At the remote site, the proportional frequency of citing instruction as a weakness was higher than at the home site in 1995, increased from 1995 to 1996, and then decreased from 1996 to Spring, 1997 (SR= -2.5). At the home site, the proportional frequency of citing

instruction as a weakness exhibited a random fluctuation decreasing slightly from 1995 to Spring, 1997, increasing in Fall 1997, and decreasing in 1998.

Student behavior weaknesses were reported with low proportional frequency in 1995 (SR = -2.2) but increased in 1996 (SR = 2.32) and Spring, 1997 (SR = 2.09) at the home site. At the remote site student behavior weaknesses were reported less frequently from 1995 to 1996 (SR = -4) and then increased in Spring, 1997. All categories exhibited a relatively constant proportional frequency after the Spring, 1997, semester.

Conclusion

As expected, strengths were perceived differently by home and remote site respondents. At the home site sociability or meeting new people was important. At the remote site access was important. In addition, the proportion of responses citing student behavior as a strength has increased across semesters. The learning and access strengths were cited with relatively equal frequency across semesters.

The weakness responses required a three-way interaction between weakness, site, and semester. The proportion citing equipment weaknesses has decreased consistently across semesters at both home and remote sites. Obviously there has been improvement in maintenance and care of equipment in this program. In addition, scheduling problems are cited with increasing frequency across semesters at both sites reaching a proportional peak in Spring, 1997, and remaining there for the following two semesters. There were, however, differences in the instruction and student behavior weaknesses based on semester and site.

Remote site respondents reported more weaknesses in instruction (interaction with the

teacher, 1-on-1 with the teacher) in 1996 than in 1995 and 1997. Apparently in 1995 and increasingly in 1996, interaction of the teacher with remote site respondents was difficult. By 1997 this problem had been resolved. Home site respondents, on the other hand, reported weaknesses in instruction with decreasing frequency after 1995 and have remained relatively stable across semesters.

Remote site respondents also reported student behavior as a weakness less frequently in 1996 than in 1995 and 1997. Student behavior at the remote site (cheating, lack of discipline, absence) appeared to improve in 1996. In addition, home site respondents reported student behavior as a weakness with increasing frequency across semesters. This weakness, however continues to be a concern at both home and remote sites.

Student behavior was considered a strength and a weakness in this analysis. It should be noted that responses to the strength category in student behavior were citing better study habits and better listening skills. Weaknesses in student behavior cited cheating, discipline, and absence. While both responses pertain to a student's behavior, they represent opposing ends of the spectrum

An increasing proportion of the respondents at both home and remote sites are citing scheduling weaknesses across semesters. This is the most frequently cited weakness at both home and remote sites in 1997. Respondents suggest those schools in the same network should be on the same schedule and have the same snow schedule.

It was also concluded that the use of log-linear modeling provided a more appropriate method of analysis for this data. If weaknesses had been analyzed by two χ^2 tests of independence – one site by weakness, and one semester by weakness – results would have

differed. The only difference between sites would have been in instruction with the home site reporting instruction as a weakness less frequently than expected and the remote site reporting instruction more frequently than expected. Across semesters, Equipment would have been cited more frequently than expected in 1995 and 1996. Student Behavior would have been reported as a weakness more frequently than expected in 1997 than less than expected in 1995. The discrepancy in Student Behavior between home and remote sites in 1995 and 1996 would not have been noticed. In addition, Instruction would have been reported as a weakness less frequently in 1997 and more frequently in 1996. Instruction weakness citations have been relatively stable proportionately at the home site. Only the remote site has shown significant changes. This would not have been detected in χ^2 analyses.

Another problem noted in this analysis was concerned with the "open-ended" questions about strengths and weaknesses of the program. These questions were converted to choices on the 1997 survey instrument with the respondent rating the top three strengths or weaknesses using the categories provided. There was a corresponding increase in number of responses. However, it is unknown whether the respondent believed these responses were worthy of notice, or if the respondent was simply cooperating by answering the questions. Even though an 'other' category with blank lines was given, it was seldom used. Future surveys should return to the open-ended blank lines. Then a response is written only if the respondent believes it needs to be included and, no responses are suggested by the instrument.

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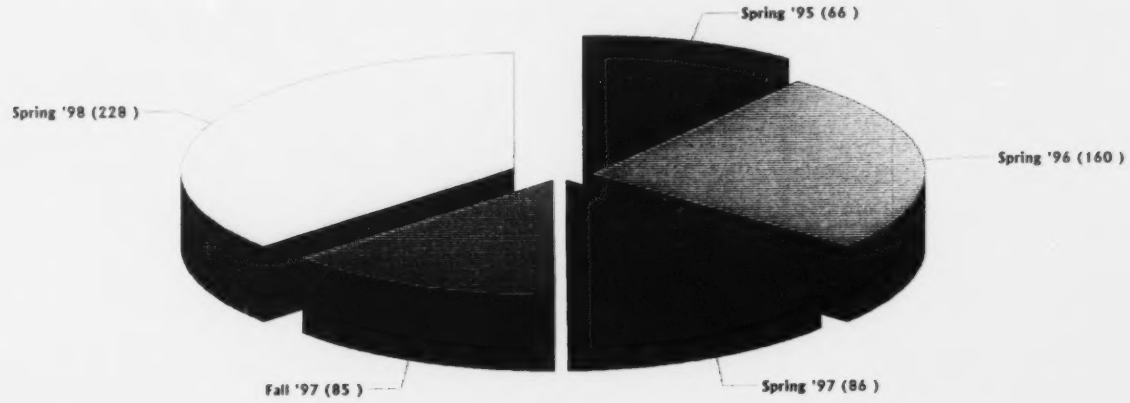
Figure 1

Number of Respondents
by Semester and Year



Remote (N=397)

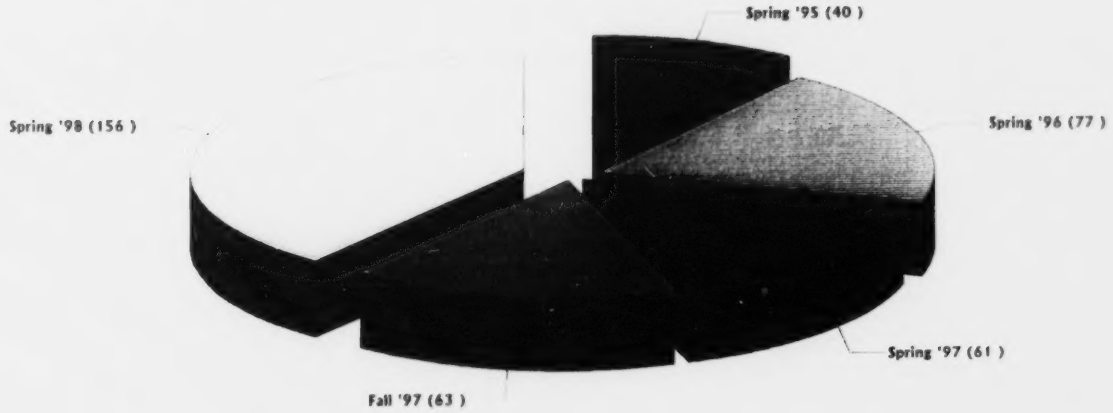


Figure 2

Strengths (HS Students 1995-1998)

Site/Semester (Proportion by Year)

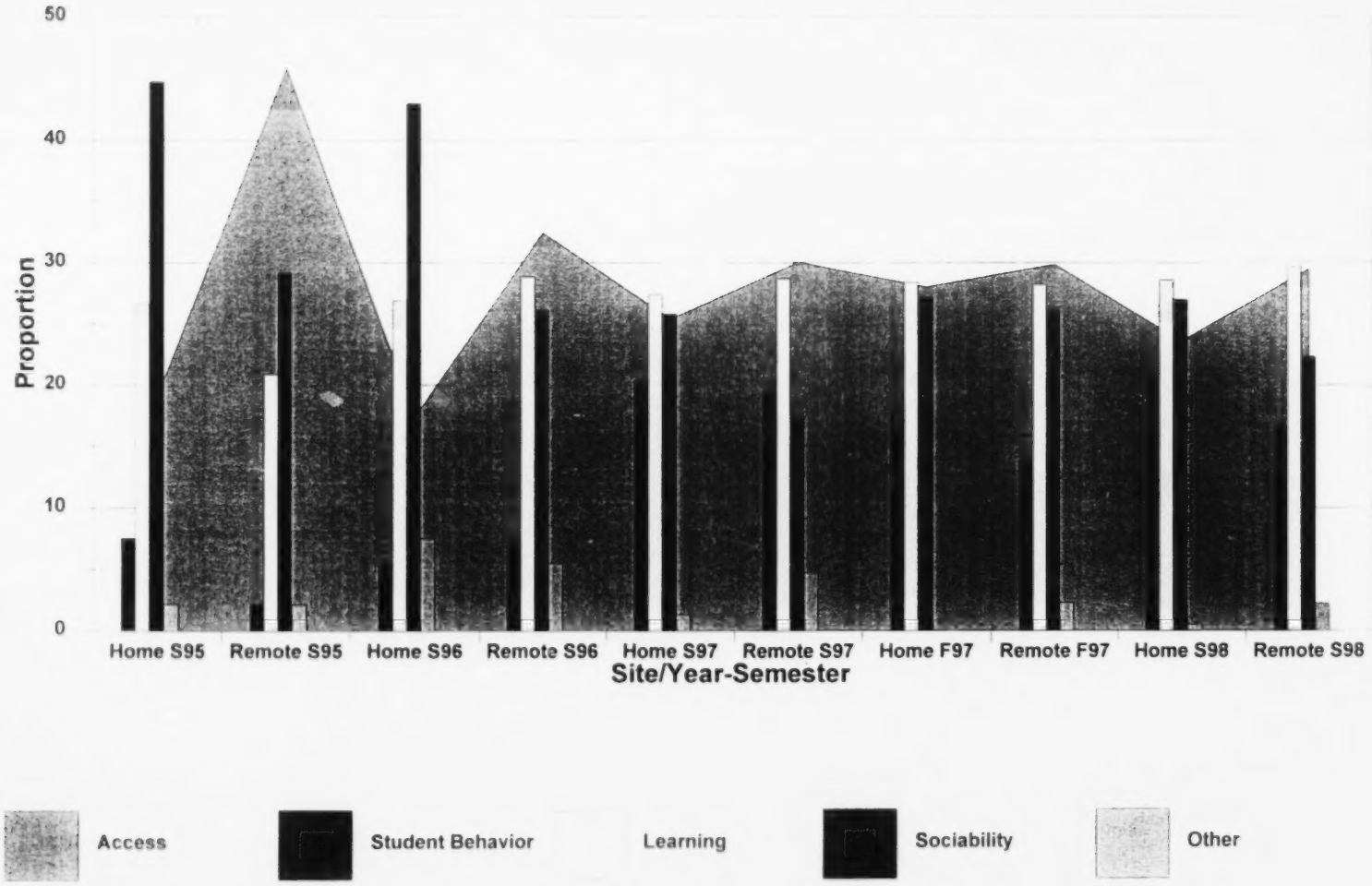


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Figure 3

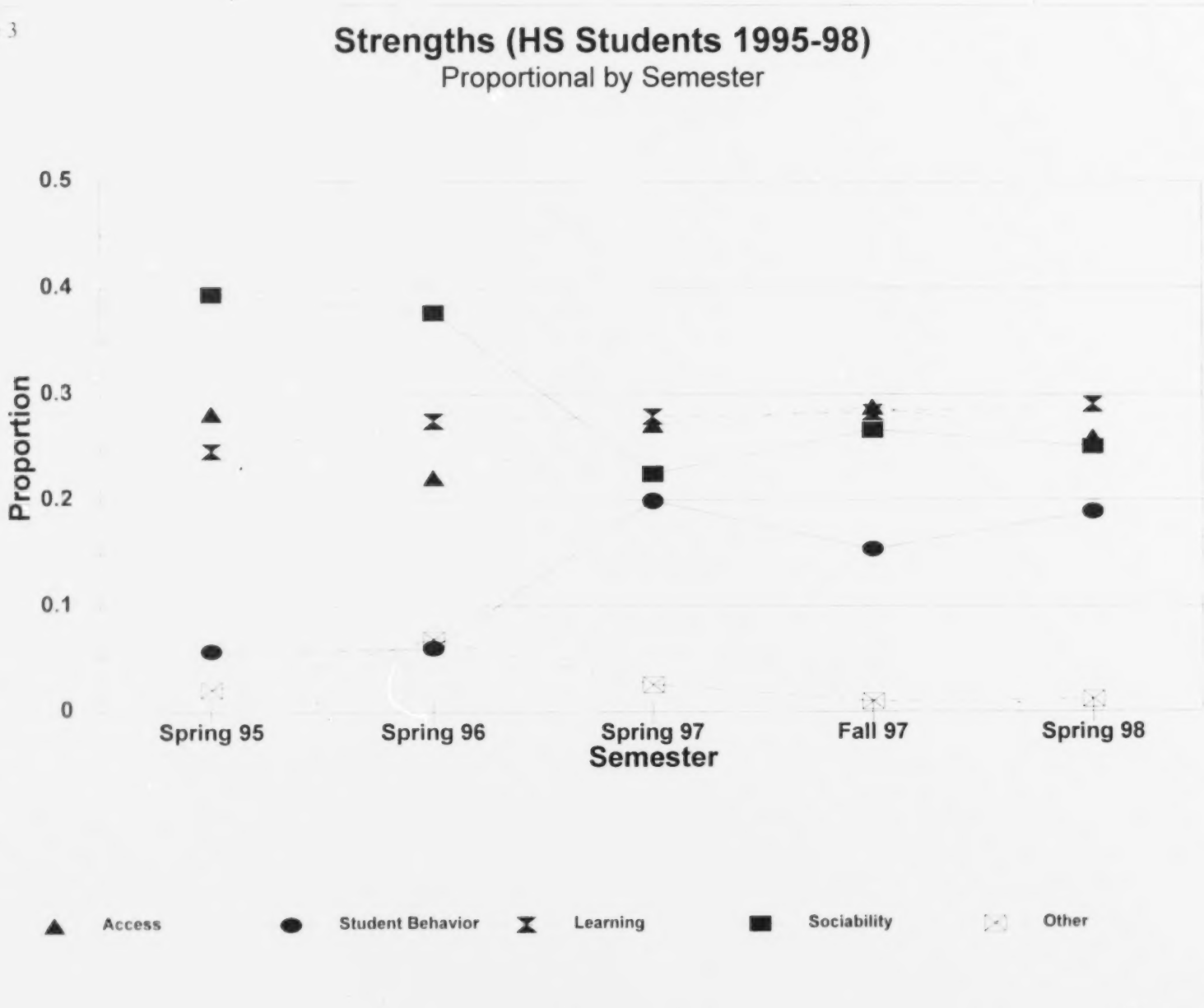
Strengths (HS Students 1995-98)
Proportional by Semester
0.5
0.4
0.3
0.2
0.1
0
Proportion
Spring 95
Spring 96
Spring 97
Fall 97
Spring 98
Semester
Access
Student Behavior
Learning
Sociability
Other

Figure 4

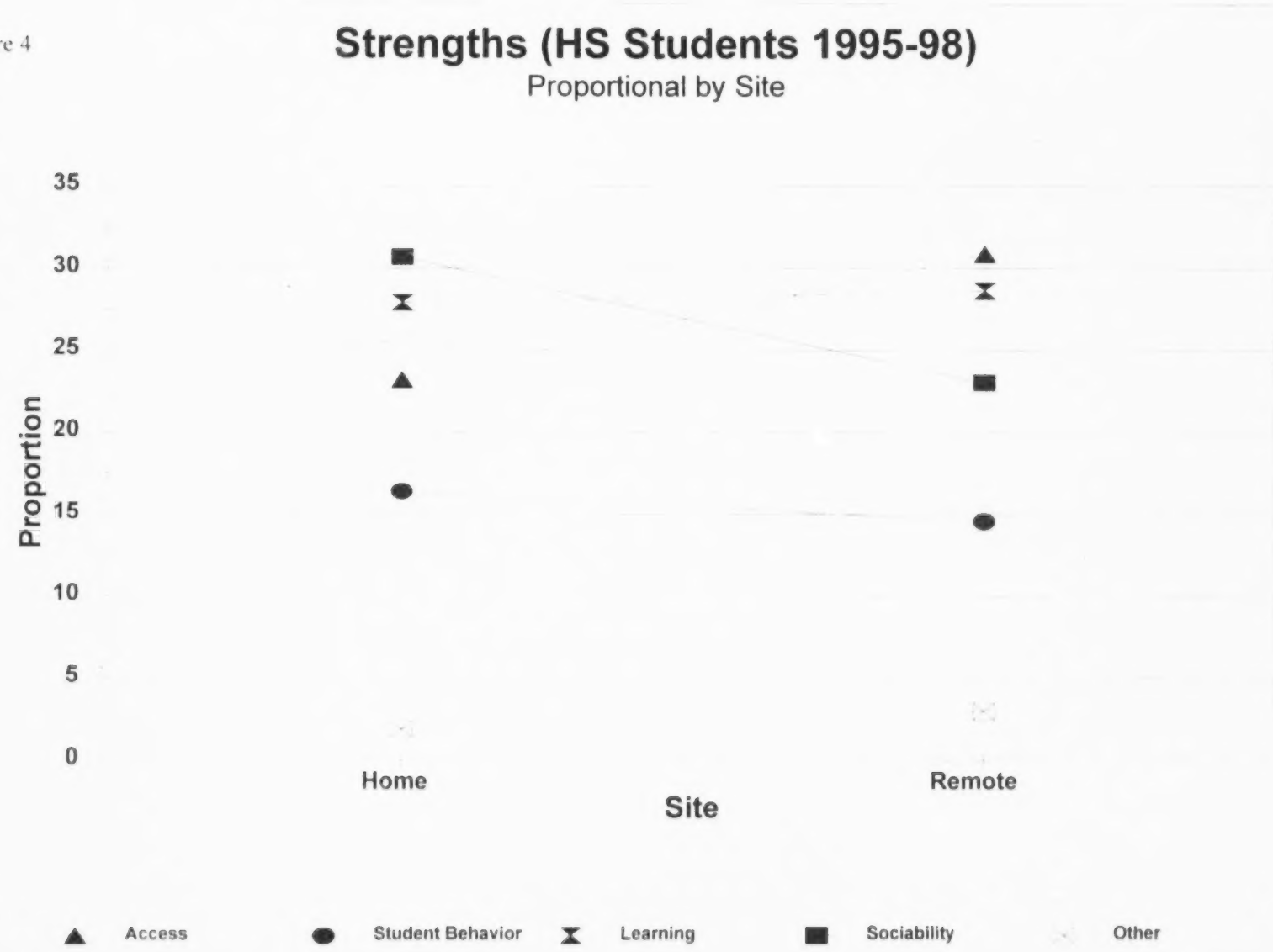
Strengths (HS Students 1995-98)
Proportional by Site
35
30
25
20
15
10
5
0
Proportion
Home
Remote
Site
Access
Student Behavior
Learning
Sociability
Other

Figure 5

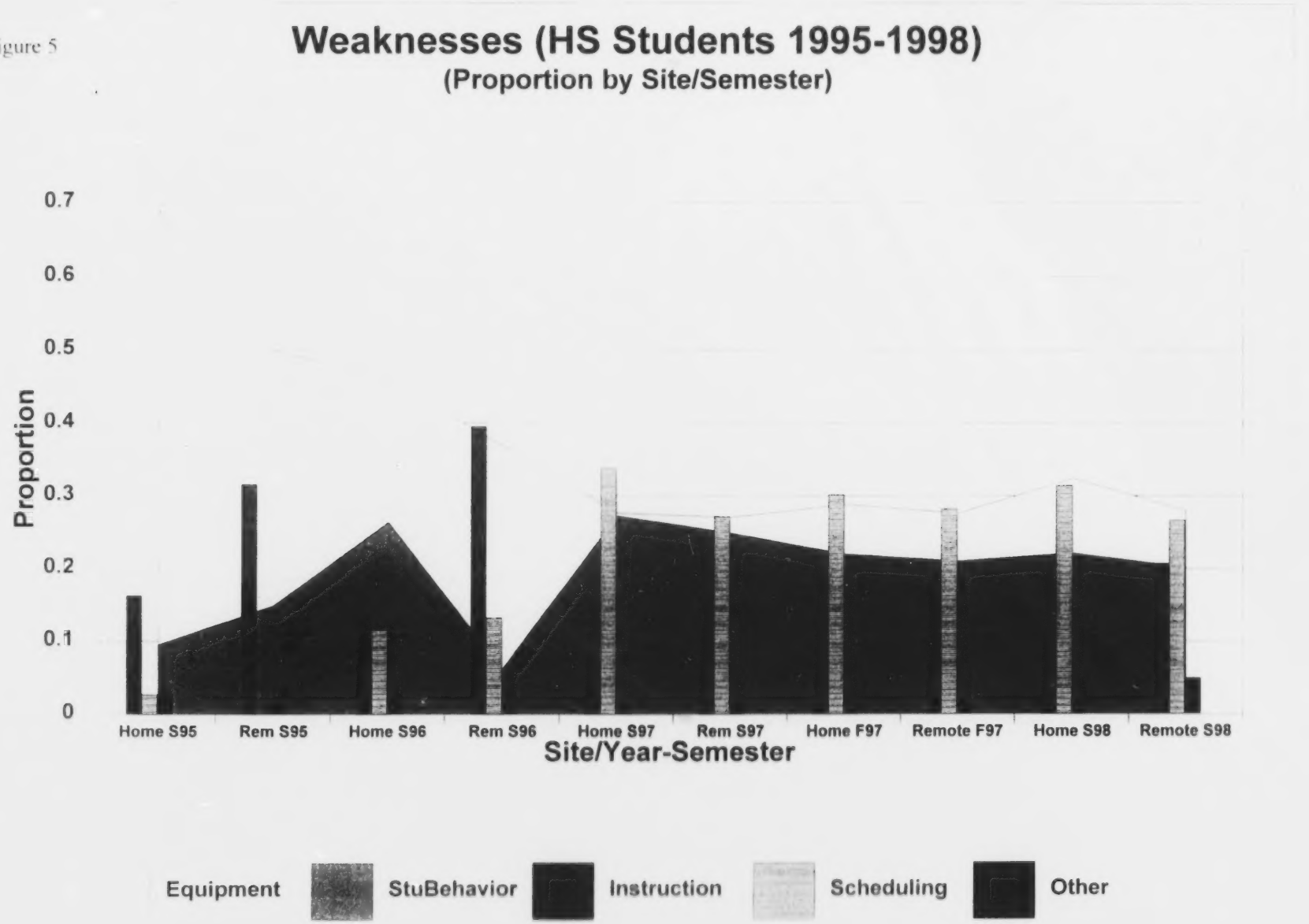

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Figure 6

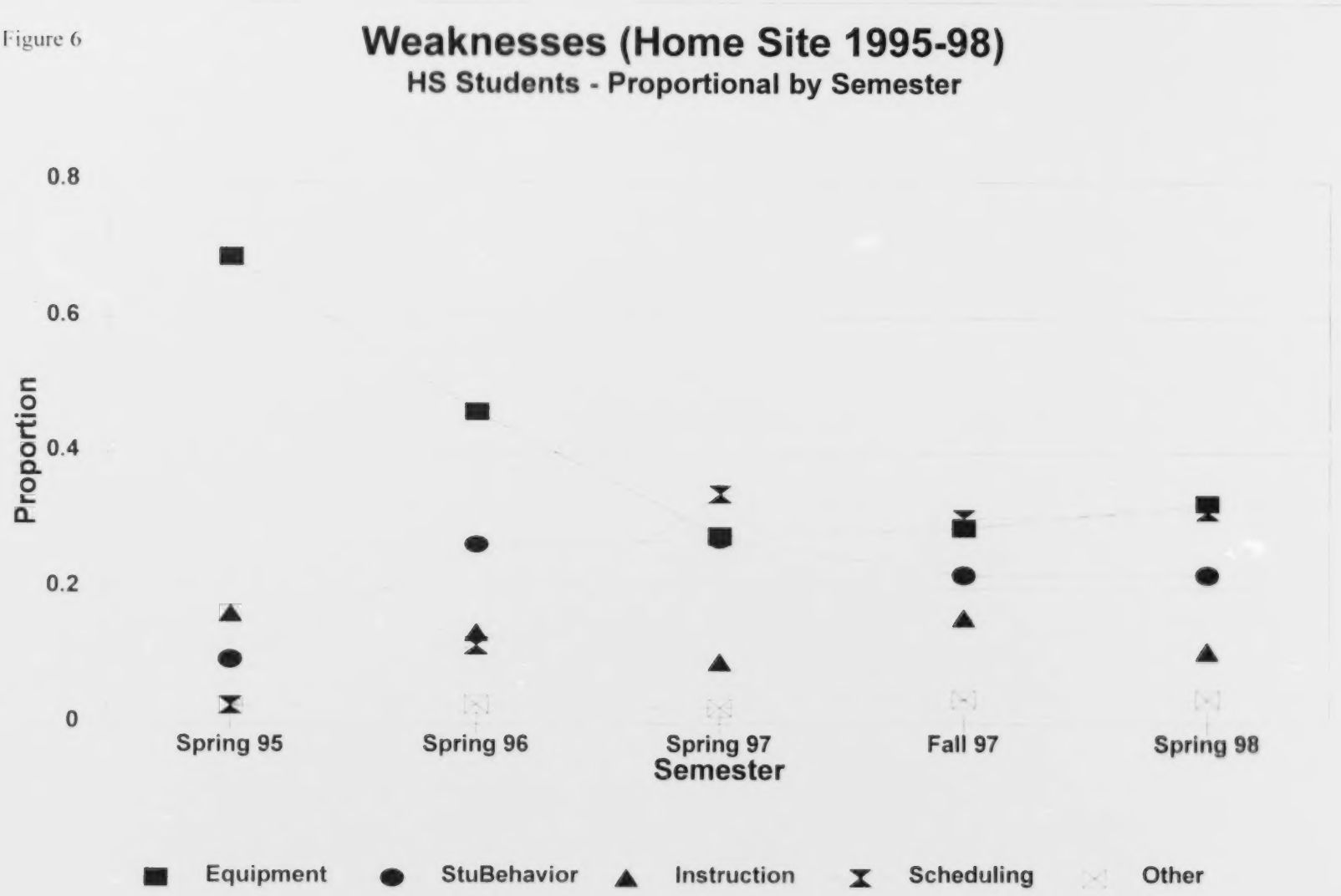
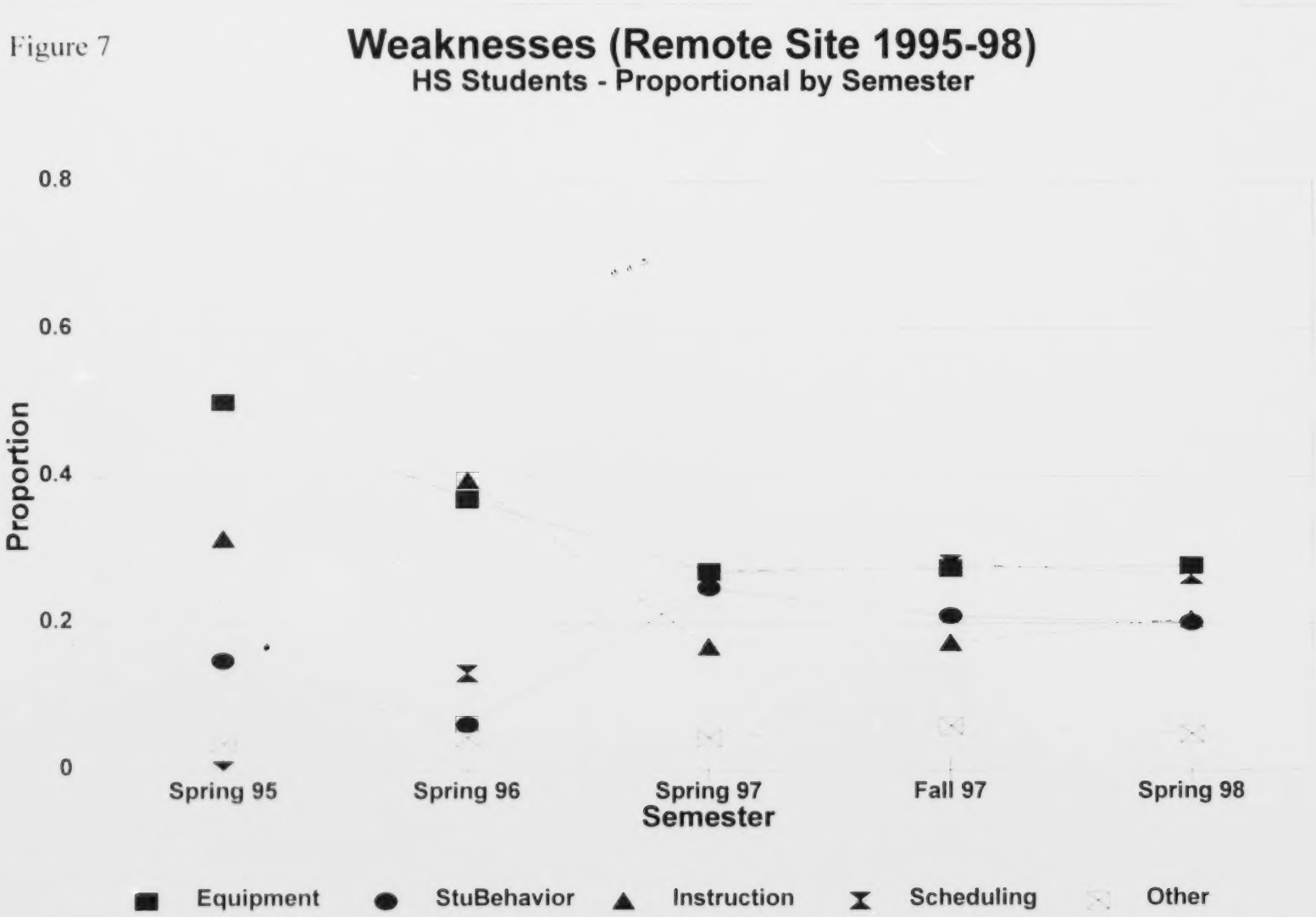

Weaknesses (Home Site 1995-98)
HS Students - Proportional by Semester
0.8
0.6
0.4
0.2
0
Proportion
Spring 95
Spring 96
Spring 97
Fall 97
Spring 98
Semester
Equipment
StuBehavior
Instruction
Scheduling
Other

Figure 7


Weaknesses (Remote Site 1995-98)
HS Students - Proportional by Semester
0.8
0.6
0.4
0.2
0
Proportion
Spring 95
Spring 96
Spring 97
Fall 97
Spring 98
Semester
Equipment
StuBehavior
Instruction
Scheduling
Other